INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

AERONAUTICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**AERODYNAMICS AND PROPULSION LABORATORY**				
Course Code	AAEB12				
Programme	B.Tech				
Semester	IV	AE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	-	-	-	2	1
Chief Coordinator	Ms. Ch Ragha Leena, Assistant Professor				
Course Faculty	Dr. K Maruthupandiyan, Associate Professor Ms. Ch Ragha Leena, Assistant Professor				

I. COURSE OVERVIEW:

The aim of this course is to understand the behavior of flow properties over different models and to study flow visualization over aerodynamic bodies using low speed subsonic wind tunnel and to study the basic principle of Gas Turbine engine and its performance parameters. Experimental results are verified analytically.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AAEB02	IV	Engineering Thermodynamics	3
UG	AAEB03	IV	Fluid Dynamics	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Aerodynamics and Propulsion Laboratory	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Marker & Talk	✘	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✘	Seminars	✘	Mini Project	✘	Videos
✔	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria:

20 %	To test the preparedness for the experiment.
20 %	To test the performance in the laboratory.
20 %	To test the calculations and graphs related to the concern experiment.
20 %	To test the results and the error analysis of the experiment.
20 %	To test the subject knowledge through viva – voce.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Table 1: Assessment pattern for CIA

Component	**Laboratory**		**Total Marks**
Type of Assessment	Day to day performance	Final internal lab assessment	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):
One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Preparation	**Performance**	**Calculations and Graph**	**Results and Error Analysis**	**Viva**	**Total**
2	2	2	2	2	10

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Presentation of real world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Calculations of the observations
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	1	Lab Practices
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Term observations

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional skills:** Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products	1	Lab Practices
PSO2	**Problem-solving Skills:** Imparted through simulation language skills and general purpose CAE packages to solve practical, design and analysis problems of components to complete the challenge of airworthiness for flight vehicles.	--	--
PSO 3	**Practical implementation and testing skills:** Providing different types of in house and training and industry practice to fabricate and test and develop the products with more innovative technologies	--	--

PSO 4	**Successful career and entrepreneurship:** To prepare the students with broad aerospace knowledge to design and develop systems and subsystems of Aeronautical/aerospace allied systems to become technocrats.	--	--

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES :

The course should enable the students to:	
I	Understand the behavior of flow properties over different models using subsonic wind tunnel
II	Demonstrate experimentally the pressure distribution over circular, symmetric and cambered airfoils and evaluate lift and drag.
III	Illustrate flow visualization studies at low speeds over different aerodynamic bodies.
IV	Understand the basics of propulsion, working principles of reciprocating engines, performance estimation based on rotation angles, and components of engine and their functions
V	Knowledge about the operation of valves, ports and their functioning in four stroke and two stroke engines.
VI	Calculation of percentage of carbon residue and flash and fire point temperatures of a Lubricating Oil.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AAEB12.01	CLO 1	Understand the behavior of flows around different structured objects.	PO 1	2
AAEB12.02	CLO 2	Understand the aerodynamic properties of flow over an airfoil.	PO 1	2
AAEB12.03	CLO 3	Differentiate the flow properties around symmetrical and cambered airfoil	PO 1, PO 2, PO 3, PO 4	2
AAEB12.04	CLO 4	Understand the aerodynamic properties for flow through cylinder.	PO 1, PO 2	1
AAEB12.05	CLO 5	Observe the properties at separation region and wake region of circular cylinder at different Reynolds numbers	PO 1, PO 2, PO 3	2
AAEB12.06	CLO 6	Analyze the coefficient of pressure, lift, drag and moment for different bodies for different flow conditions.	PO 1, PO 2, PO 3	1
AAEB12.07	CLO 7	Compare the efficiency of blower test rig for 3 different vane settings.	PO 1, PO 2, PO 3	2
AAEB12.08	CLO 8	Observe flow properties and compare the computation results with experimental results	PO 2, PO 3	1
AAEB12.09	CLO 9	Analyze thermal, propulsive and overall efficiency of turbo jet cycle.	PO 1, PO 3	1

AAEB12.10	CLO 10	Compare calorific value of different fuels and materials using digital bomb calorimeter and optimizing astute fuels	PO 1, PO 3	2
AAEB12.11	CLO 11	Analyze propeller efficiency and thrust availability using propeller test rig at various blade pitch angles.	PO 1,PO 2, PO 3	2
AAEB12.12	CLO 12	Examine work, power and Thrust requirement in gas turbine- combustion power input, work heat relationship.	PO 1, PO 3	2
AAEB12.13	CLO 13	Understand T-S, H-S diagrams for the gas turbine and compare efficiencies of non-ideal engine components.	PO 1,PO 2, PO 3, PO 4	3

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X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO 1	2															
CLO 2	2															
CLO 3	2	2	1	1												
CLO 4	1	1											1			
CLO 5	2	1	2													
CLO 6	1	1	1													
CLO 7	2	1	2										1			
CLO 8		1	1													
CLO 9	1		1													
CLO 10	2		2													
CLO 11	2	1	2													
CLO 12	2		2													
CLO 13	3	3	2	2									1			
CLO 14	3	3	2	2									1			

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2 PO 3, PO 4	SEE Exams	PO 1, PO 2 PO 3, PO 4	Assignments	-	Seminars	-
Laboratory Practices	PO 1, PO 2 PO 3, PO 4	Student Viva	-	Mini Project	-	Certification	-

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

LIST OF EXPERIMENTS	
Week-1	**CALIBRATION AND PRESSURE DISTRIBUTION-CYLINDER**
Calibration of subsonic wind tunnel, Pressure distribution over cylinder.	
Week-2	**PRESSURE DISTRIBUTION AND FLOW VISUALIZATION - SYMMETRIC, CAMBERED AIRFOIL**
Pressure distribution and flow visualization over symmetric, cambered airfoil	
Week-3	**FORCE MEASUREMENT**
Force measurement using wind tunnel balance.	
Week-4	**WAKE ANALYSIS**
Wake analysis over a cylinder and airfoils	
Week-5	**FLOW OVER A FLAT PLATE**
Flow over a flat plate	
Week-6	**BLOWER TEST RIG**
Efficiency of blower test rig for 3 different vane settings.	
Week-7	**GAS TURBINE PARAMETERS CALCULATION**
Calculation of work, power and Thrust requirement in gas turbine- combustion power input, work heat relationship.	
Week-8	**GAS TURBINE EFFICIENCY AND PERFORMANCE DIAGRAMS**
Elucidate T-S, H-S diagrams for the gas turbine and compare efficiencies of non-ideal engine components.	
Week-9	**GAS TURBINE EFFICIENCY CALCULATIONS**
Calculation of thermal, propulsive and overall efficiency of turbo jet cycle.	

Week-10	**NOZZLE PERFORMECE**
Calculation of various nozzle performance with airflow	
WeeK-11	**CALORIFIC VALUE OF DIFFERENT FUELS**
Calculation of calorific value of different fuels and materials using digital bomb calorimeter and optimizing astute fuels	
Week-12	**PROPELLER TEST RIG**
Calculation of propeller efficiency and thrust availability using propeller test rig at various blade pitch angles.	

Reference Books:

1. L. J. Clancy, ―Aerodynamics", Pitman, 1st Edition, 1986.
2. Alan pope, ―Low Speed Wind Tunnel Testing‖, John Wiley, 2nd Edition, 1999.
3. N. M. Komerath, ―Low Speed Aerodynamics‖, Extrovert, 1st Edition, 2012.

XIV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Week No.	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Calibration of subsonic wind tunnel, Pressure distribution over cylinder.	CLO 1	R1: 1.2
2	Pressure distribution and flow visualization over symmetric, cambered airfoil	CLO 2	R2: 3.5
3	Force measurement using wind tunnel balance.	CLO 3, CLO 4	R1: 3.4
4	Wake analysis over a cylinder and airfoils	CLO 5	R1: 2.2
5	Flow over a flat plate	CLO 8	R1: 2.4
6	Efficiency of blower test rig for 3 different vane settings.	CLO 9	R3: 4.5
7	Calculation of work, power and Thrust requirement in gas turbine- combustion power input, work heat relationship.	CLO 10, CLO 11	R2: 2.6
8	Elucidate T-S, H-S diagrams for the gas turbine and compare efficiencies of non-ideal engine components.	CLO 10, CLO 11	R2: 2.6
9	Calculation of thermal, propulsive and overall efficiency of turbo jet cycle.	CLO 13, CLO 14	R1: 5.2
10	Calculation of various nozzle performance with airflow	CLO 13, CLO 14	R1: 5.2
11	Calculation of calorific value of different fuels and materials using digital bomb calorimeter and optimizing astute fuels	CLO 13, CLO 14	R1:7.2
12	Calculation of propeller efficiency and thrust availability using propeller test rig at various blade pitch angles.	CLO 18	R1:7.3

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Interpretation of results by testing various models	Guest Lectures	PO 1, PO 2, PO 4	PSO 1, PSO 3 PSO 4
2	Encourage students to design and analyze beams using CFD software	NPTEL	PO 2, PO 3	PSO 1, PSO 3, PSO 4

Prepared by:
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